

WHAT IS CLAIMED IS:

1. A method for quantitatively determining a parameter of a fluid having a physical property, said fluid being disposed in a vessel into which flows a first portion of said fluid having a first value of said physical property, and out of which vessel flows a second portion of said fluid having a corresponding second value of said physical property, said method comprising:

altering the first value of said physical property of the first portion of said fluid;

measuring the difference between the first and second values of said physical property; and

interpreting the difference between the first and second values of said physical property in a manner which provides for quantitatively determining a parameter of said fluid.

2. A method as defined in Claim 1 wherein:

the step of altering the first value of said physical property of the first portion of said fluid further comprises:

injecting a marker fluid having a value of said physical property different from the first value of the physical property of the first portion of said fluid into the first portion of said fluid.

3. A method as defined in Claim 1 wherein the step of measuring the difference of the first and second values of said physical property further comprises:

flowing the first portion of said fluid through a first conduit, said first conduit comprising a first measuring cell with a first continuous path configuration; and

measuring the first value of said physical property in the first portion of the fluid in the first measuring cell.

4. A method as defined in Claim 3 wherein said physical property of said fluid is conductivity, and

the measuring step further comprises:

positioning an inducing device as part of or in proximity with the first measuring cell at an inducing location; and

using the inducing device to induce a first current in first direction along the continuous path of the first measuring cell;

positioning a sensing device as part of or in proximity with the first measuring cell at a sensing location; and

sensing the first current in the first portion of said fluid in the first measuring cell.

5. A method as defined in Claim 1 wherein either of the measuring and interpreting steps further comprise compensating for the effect of the first value of the physical property of the first portion of the fluid as the first value of the physical property was prior to the altering step.

6. A method as defined in Claim 1 wherein the step of measuring the difference of the first and second values of said physical property further comprises:

flowing the second portion of said fluid in a second conduit, the second conduit having a second measuring cell with a second continuous path configuration and

measuring the second value of said physical property of the second portion of the fluid in the second measuring cell.

7. A method as defined in Claim 1 wherein the step of measuring the difference of the first and the second values of said physical property further comprises:

flowing the first portion of said fluid through a first conduit, said first conduit comprising a first measuring cell with a first continuous path configuration;

flowing the second portion of said fluid through a second conduit, said second conduit comprising a second measuring cell with a second continuous path configuration;

wherein said measuring step includes measuring the difference between the first value of said physical property in the first portion of the fluid in the first measuring cell and the second value of said physical property in the second portion of the fluid in the second measuring cell; and

producing a signal representative of the difference of the first and second values of said physical property in the first and the second portions of the fluid.

8. A method as defined in Claim 3 wherein:

the step of altering the first value of said physical property of the first portion of said fluid further comprises:

altering the first value of said physical property of the first portion of said fluid prior to the flowing of said first portion of said fluid through said first measuring cell.

9. A method as defined in Claim 3 wherein:

the altering step further comprises:

altering the first value of said physical property after the flowing of said first portion of said fluid through the first measuring cell.

10. A method as defined in Claim 1 wherein either of the measuring and interpreting steps further comprise compensating for the effects of either of the first and the second values of said physical property.

11. A method as defined in Claim 1 wherein the fluid is blood and the first portion of said fluid is treated blood being delivered from a hemodialysis apparatus.

12. A method as defined in Claim 1 wherein the fluid is blood and the second portion of said fluid is untreated blood being delivered to a hemodialysis apparatus.

13. A method as defined in Claim 1 wherein the fluid parameter is a measure of flow.

14. A method as defined in Claim 1 wherein the fluid parameter is a measure of recirculation.

15. An apparatus for quantitatively determining a parameter of a fluid having a physical property, said fluid being disposed in a vessel into which flows a first portion of said fluid having a first value of said physical property, and out of which vessel flows a second portion of said fluid having a corresponding second value of said physical property, said apparatus comprising:

means for altering the first value of said physical property of the first portion of said fluid; and

means for measuring the difference between the first and second values of said physical property; and

means for interpreting the difference between the first and second values of said physical property to quantitatively determine a parameter of said fluid.

16. An apparatus as defined in Claim 15 wherein:

the means for altering the first value of said physical property of the first portion of said fluid further comprises:

means for injecting a marker fluid having a value of said physical property different from the first value of said physical property of the first portion of said fluid into the first portion of said fluid.

17. An apparatus as defined in Claim 15 wherein the means for measuring the difference of the first and second values of said physical property of the respective first portion of said fluid and the second portion of said fluid further comprises:

a first conduit through which the first portion of said fluid flows to the vessel, said first conduit comprising a first measuring cell with a first measuring cell upstream connection, a first measuring cell downstream connection, and two branches connecting the upstream connection to the downstream connection with a first continuous path configuration from the upstream connection to the downstream connection through one of the two branches and returning to the upstream connection through the other one of the two branches;

means for measuring the first value of said physical property in the first portion of said fluid in the first measuring cell.

18. An apparatus as defined in Claim 17 wherein the physical property of said fluid is conductivity, and

the measuring means comprises an inducing device as part of or disposed in proximity with the first measuring cell at an inducing location; and

a sensing device as part of or disposed in proximity with the first measuring cell at a sensing location.

19. An apparatus as defined in Claim 15 wherein either of the means for measuring and the means for interpreting further comprises means for compensating for the effect of the first value of said physical property of the first portion of the fluid as the first value of said physical property was prior to any alteration thereof.

20. An apparatus as defined in Claim 15 wherein the means for measuring the difference of the first and second values of said physical property further comprises:

a second conduit through which the second portion of said fluid having the second value of the physical property flows from the vessel, the second conduit having a second measuring cell with a second continuous configuration wherein the means for inducing further comprises:

means for measuring the second value of the physical property in the second portion of said fluid in the second measuring cell following the second continuous path configuration.

21. An apparatus as defined in Claim 17 wherein:

the means for altering the electrical conductivity of the value of said first physical property of the first portion of said fluid is disposed so as to alter said first physical property of the first portion of said fluid prior to the flowing of said first portion of said fluid through said first measuring cell.

22. An apparatus as defined in Claim 15 wherein the means for measuring the difference of the first and the second values of said physical property further comprises:

a first conduit through which the first portion of said fluid flows to the vessel, said first conduit comprising a first measuring cell with a first measuring cell upstream connection, a first measuring cell downstream connection, and two branches connecting the upstream connection to the downstream connection with a first continuous path configuration from the upstream connection to the downstream connection through one of the two branches and returning to the upstream connection through the other one of the two branches;

a second conduit through which the second portion of said fluid flows from the vessel, said second conduit comprising a second measuring cell with a second measuring cell upstream connection, a second measuring cell downstream connection, and two branches connecting the upstream connection to the downstream connection with a second continuous path configuration from the upstream connection to the downstream connection through one of the two branches and returning to the upstream connection through the other one of the two branches;

wherein said means for measuring includes measuring the difference between the first value of said physical property of the first portion of said fluid in the first measuring cell and the second value of said physical property of the second portion of said fluid flowing in the second measuring cell, and

means for producing a signal representative of the difference of the first and second values of said physical property of the first and the second portions of said fluid.

23. An apparatus as defined in Claim 15 wherein:

the altering means for altering the value of said first physical property of the first portion of said fluid is disposed so as to alter the value of said first physical property of the first portion of said fluid after the flowing of said first portion of said fluid through said first measuring cell.

24. An apparatus as defined in Claim 15 further comprising an apparatus adapted for interpreting the difference between the first and second values of said physical property for quantitatively determining the degree of flow recirculation within a vessel.

25. An apparatus as defined in Claim 15 wherein the fluid is blood and the first portion of said fluid is treated blood being delivered from a hemodialysis apparatus.

26. An apparatus as defined in Claim 15 wherein the fluid is blood and the second portion of said fluid is untreated blood being delivered to a hemodialysis apparatus.

27. An apparatus as defined in Claim 15 wherein the fluid parameter is a measure of flow.